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ABSTRACT

A conditions-based approach to the development of microlevel organizational strategies for instruction is explored. The conditions model reflects the idea that differences in learning tasks, primarily qualitative differences in the cognitive processing required of different learning tasks, can suggest different ways by which instruction can either supply the processing needed or assist learners to generate the needed processing. A perceived limitation has been the idea that conditions-based models prescribe only supplantive instruction or that the models are inherently biased toward supplantation. This limitation is overcome in a recent work (Smith and Ragan, 1993), which presents a revision of the events of instruction in which both generative and supplantive interpretations are suggested by the wording of each event. Strategy recommendations using the expanded events of learning are presented in summary sheets for (1) declarative knowledge; (2) concept learning; (3) procedural rule learning; (4) relational rule learning; (5) problem solving; (6) attitude learning; and (7) learning psychomotor skills. (Contains 70 references.) (SLD)

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Title:

Opening the Black Box: Instructional Strategies Examined

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This paper will explore a conditions-based approach to development of micro-level organizational strategies for instruction. The paper draws upon ideas generated during development of the recently-published text, *Instructional Design* (Smith and Ragan, 1993) as well as subsequent work.

Reigeluth (1983) presents three components of instructional strategy: organizational, delivery, and management strategies. Organizational strategies refer to content presentation and sequence concerns, delivery strategies refer to media and grouping concerns and management strategies refer to matters of scheduling and resource allocation. Although all three components are of concern to instructional designers, organizational strategies are both the primary concern for this paper and are a component which has profound influence on the other components as well. Little prescription has been said to be available (the "black box") for organizational strategies: how will information be presented, what content will be explored, in what activities will learners engage? What will happen during instruction in what sequence or by what sequence-controlling event(s)?

Too often in instructional design literature, (or in common perceptions of the literature) when the focus of the design process is on the "develop instructional strategy," prescription is replaced with "just do it." In phases of the design process both before and after strategy development, instructional design technology has justified the term "technology." Principles and procedures abound to guide the designer in performing instructional analysis; the same can be said for development of assessments and for conducting summative and formative evaluation. But in strategy development, too often the principles which would guide one in making decisions have been clouded in mystery. It is a classic case of the "black box" in which both inputs and outputs are known, but the process itself appears to be unknown.

It is our contention that more is known that is of a prescriptive nature regarding the design of instructional strategies, specifically organizational strategies, than is generally acknowledged. The literature has been scattered and difficult to synthesize into a coherent whole. And. although the authors present an approach which itself is a synthesis, it is not a synthesis of *everything* out there on instructional strategies, since thus far a reconciliation of all potentially useful points of view has not been possible.

The approach to be discussed rests on what can be described as the "conditions model" of instruction. The conditions model reflects the idea that differences in learning tasks, primarily qualitative differences in cognitive processing required of different learning tasks, can suggest different ways by which instruction can either *supply* the processing needed or assist learners to *generate* the needed processing. The conditions model is most widely known in the work of R.M. Gagné (1985), but is also evident in work by many others including Merrill (1983), Reigeluth (1983), Landa (1974), and Tennyson (1986).
Although there are questions about and limitations of the conditions model which we may not be able answer or rebut at present (e.g., concerns from the constructivist orientation about the feasibility of having stable enough "objectives" for learning to analysis and subsequent instruction based on those objectives), there is one important perceived limitation in this approach which we believe we have surmounted and which, in so doing, greatly expands the reasonableness and utility of the model. That limitation has been more perceived than real, in our view, yet it appears that ours may be the first sufficient explication to thoroughly counter the argument of this particular limitation. That limitation has been the notion that conditions-based models (and by association, the "instructional design" approach) prescribe only supplantive instruction or that the models are inherently biased toward supplantation.

It is easy to see how the idea that conditions models are associated with supplantive strategies, even though we believe this association to be largely the result of miscommunication and misunderstanding. A good example of what might lead a person to assume that the conditions models suggest supplantive strategies is seen in the wording of the "events of instruction" (Gagné. 1972):

1. Gaining attention
2. Informing the learner of the objective
3. Stimulating recall of prerequisite learning
4. Presenting stimulus material
5. Providing learning guidance
6. Eliciting performance
7. Providing feedback
8. Assessing performance
9. Enhancing retention and transfer

Gagné's explanations of the events of instruction occasionally suggest that he may have intended that the events could at times be other than "instruction-supplied" even though such suggestion is not present in the way the events are worded.

Regardless of Gagné's original intent, it is easy to view events of instruction from a position which is neutral with regard to the supplantive/generative question, placing the selection of strategy in that regard an element in the design process.

In the present author's recent text (Smith and Ragan, 1993), a revision of the events of instruction, which we label "expanded events of instruction," is presented in which both generative and supplantive interpretations are suggesting by the wording of each event.

	Supplantive Version	Generative Version
Introduction		
1.	Gain attention to lesson	Activate attention
2.	Inform learner of purpose	Establish purpose
3.	Stimulate learner's attention	Arouse interest & motivation
4.	Provide overview	Preview lesson
Body		
5.	Stimulate recall	Recall prior knowledge
6.	Present information	Process information
7.	Gain & focus attention	Focus attention
8.	Guide or suggest use of lng. strats.	Employ learning strategies
9.	Elicit response	Engage in practice
10.	Provide feedback	Evaluate feedback
Conclusion		
11.	Provide summary & review	Generate summary & review
12.	Enhance transfer	Transfer learning
13.	Provide remotivation & closure	Remotivate and finish
Assessment		
14.	Conduct assessment	Assess performance
15.	Provide feedback and remediation	Evaluate feedback and seek remediation

Figure 1: Expanded Events of Instruction (adapted from Smith & Ragan, 1993)

We suggest that choice of instructional strategy form--from relatively supplantive to relatively generative--should be made on the basis of consideration of certain critical characteristics of the learning task, learners, and context for learning, specifically: time available for instruction, learner aptitudes, motivation, prior knowledge, availability of cognitive strategies, criticality of task, and future learning requirements. Thus, if time, learner characteristics, and so forth will allow it, the summarizing event, for example, may be generated by the learners rather than being supplied by instruction. A guideline we would propose is: make the instruction as generative as conditions allow. Here we follow a different path from those who recommend always employing a generative (exploratory, inquiry, inductive) strategy, and we take a different view from those who would always employ a supplantive one. A more extensive treatment of the generative-supplantive strategy dialogue can be seen in Smith (1985).

The neutrality of instructional events is maintained in the interest of reducing designers' assumptions or predispositions for one general form of instruction or another. Application of the expanded events should serve to reduce the frequency and validity of the criticism that instructional designers tend to develop a supplantive form of instruction, neglecting approaches which can sometimes be more desirable.

The second aspect of the expanded events concept is application to different types of learning. In the following we will describe strategy recommendations for six major types of learning: declarative knowledge, concept learning, procedural rule learning, relational rule learning, problem solving, attitude learning, and the learning of psychomotor skills. Recommendations which follow have been pulled together from many sources. First it should be acknowledged that the base of work by Gagné (1985) and Gagné and Briggs (1979) provided a point for expansion. Many of the following summary frames appear in Smith & Ragan (1993); some were developed for this paper. A few key sources are noted for each discussion and in the references section of this paper, and full references are provided in Smith and Ragan (1993).

Strategy Elements for Declarative Knowledge Learning

Introduction	
Deploy attention Arouse interest and motivation	• Use of novel, conflictual and paradoxical events, the interjection of personal/emotional elements, and making clear how the present learning relates to other learning tasks
Establish instructional purpose	• Relate instr. goals to personal goals or job reqmnts., make instrl. goals relevant, present goal in interesting format, remind lnrs. of relevant lng. strats., point out requirements for successful attainment of the obj., & let lnrs. know the form in which they need to remember.
Preview lesson	• Advance organizers or epitome can be useful form of preview, also outlines or maps.
Body	
Recall prior knowledge	• Advance organizers, use of metaphoric devices, and reviews of prerequisite concepts
Process information	• **Labels/names** **organization:** clustering and chunking **elaboration:** elaboration into sentences • **Facts/lists** **assoc** use of images **org:** expository and narrative structures, recognizing patterns, clustering and chunking, and elaboration. • **Organized discourse:** **assoc:** imagery, metaphoric devices **org:** analysis of expository and narrative structures, use of graphic organizers- frames, concept mapping **elaboration:** elaboration model
Focus attention	Underlining, listing, & reflecting; Questions: pre- & post-, embedded
Employ learning strategies	• Previously noted strategies (all but advance organizer) • Mnemonic techniques such as single use coding, pegwords, the method of loci, keywords, and the use of rhymes, stories, or jingles. • Rehearsal
Practice	• Role of practice, consider diff. needs for pract. for recall vs. recognition lng. tasks and for verbatim vs. paraphrased recall, consider needs for spaced practice, & the role of automaticity in declarative knowledge
Evaluate feedback	• Consider feedback needed for labels, facts, and lists (eval. correctness of associations of elements) as contrasted with the feedback needed for organized discourse ("understanding")
Conclusion	
Summarize and review	• Tuning cognitive structures, learner-generated summaries, interim summaries

Transfer knowledge	• Increase the number of possible connections in the learner's mental map, the role of application in a variety of settings, learners inference-making
Reinotivate and close	• Show how learning can help student.
Assessment	
Assess performance	• Care required to b congruent with objective
Feedback and remediation	• Identify and clarify needs for learning

Propositional networks: Anderson, 1976; Schema: Minsky, 1975; Rummelhart & Ortony, 1977; Cognitive process of learning: E. Gagné, 1985; Illustrations in lng. org. discourse: Duchastel, 1978; Narrative structures & lng. org. discourse: Armbruster & Anderson, 1985; Graphic organizers: Holley & Dansereau, 1984; Focusing effect of questions: Bull, 1973; Attentional effect of questions: Schramm, 1964; Mnemonic techniques: Atkinson, 1975, Pressley, Levin, & Delaney, 1982; Generative summaries, Hidi, 1985

Strategy Elements for Concept Learning

Introduction	
Deploy attention Arouse interest and motivation	• Highlight concept label, use unusual picture or humorous story regarding concept, provide interesting information on origin or history of concept, and present first matched example and nonexample. Use inquiry approach.
Establish instructional purpose	• State explicitly in expository lesson. Delay statement in inquiry lesson.
Preview lesson	• Overview process of inquiry approach. Point out importance of examples and nonexamples and practice in lesson.
Body	
Recall prior knowledge	• Review concepts constituting critical attributes of concept. Use techniques such as informal questioning, formal pretest, advance organizer, or analogy
Process information	• Expose to best example and/or definition. Emphasize criterial attributes. Consider matched examples and nonexamples. Present concept in range of settings with diversity of non relevant attributes.
Focus attention	• Isolate criterial attributes in examples with highlighting such as boldface type, color, or a simplified drawing.
Employ learning strategies	• Generate concept maps, analogies, mnemonics or images.
Practice	• Identify examples from previously unencountered instances, which range in difficulty and settings. Explain categorizations. Generate examples.
Evaluate feedback	• Feedback contains attribute isolation.
Conclusion	
Summarize and review	• Restate criterial attributes. • Repeat or paraphrase key information.
Transfer knowledge	• Apply outside classroom. • Provide further examples.

Remotivate and close	• Show how learning can help student.
Assessment	
Assess performance	• Test ability to isolate criterial attributes in examples and point out their absence in nonexamples. • Test including range of common and non relevant attributes.
Feedback and remediation	• Provide score or other performance summary. • Identify problems of over- and under- generalization.

Concept learning: Klausmeier, 1980, Merrill & Tennyson, 1977; Wilson, 1987; Strategies for teaching concepts: Tennyson & Cocchiarella, 1986; Tessmer, Wilson & Driscoll, 1990; Use of examples: Ali, 1981; Use of analogies: Newby & Stepich, 1987; Concreteness of illustrations: Smith & Smith, 1991

Strategy Elements for Relational Rule Learning

Introduction	
Deploy attention	• Curiosity-evoking situation/problem
Establish instructional purpose	• Understand/apply principle, relationship between concepts
Arouse interest and motivation	• Curiosity-evoking situation
Preview lesson	• Inquiry=directions; expository=outline
Body	
Recall prior knowledge	• Review component concepts
Process information	• Present/induct relationship, state in principle form, demonstrate application
Focus attention	• Direction & size in change of one variable when other variable(s) changes
Employ learning strategies	• Mnemonic rule statement, diagram of relationship
Practice	• Predict, explain, control changes in concept(s) based on change of another; recognize situations where rule applies; determine whether rule correctly applied
Evaluate feedback	• Information on whether rule applicable, outcome of application
Conclusion	
Summarize and review	• Change in symbol system; restate principle
Transfer knowledge	• Point out how princ. will be incorporated into prob. solving; identify life situations
Remotivate and close	• Relevance to daily lives or current probs.
Assessment	
Assess performance	• Recognize if principle applicable, apply principle to predict, explain, control
Feedback and remediation	• Identify misconceptions, over- or under- generalization

Relational rule learning: Gagné, 1985; Anderson, (1985); Strategies for teaching relational rules: Tennyson & Tennyson, 1975; Joyce & Weil, 1986

Strategy Elements for Procedural Rule Learning

Introduction	
Deploy attention	• Ask question, demonstrate procedure, describe efficiency
Establish instructional purpose	• Describe procedure to be learned and range of applicability
Arouse interest and motivation	• Emphasize efficiency & reliability of procedure
Preview lesson	• Preview procedure in chunks
Body	
Recall prior knowledge	• Review component comcepts, sub procedures, or related principle
Process information	• Simplify complex procedures, situations that require proced., steps in procedure order of steps, how to eval. corr. of applic. May elab. over several iterations
Focus attention	• Critical char's of situations requiring procedure, key cues to transitioning between steps, keywords for each step, cues for correct completion of procedure.
Employ learning strategies	• Job aid, mnemonic for order of steps
Practice	• Identify situations requiring procedure, order of steps, completion of steps, correct completion of procedure
Evaluate feedback	• Correct answer w/ explan., checklist or rating scale, video feedback
Conclusion	
Summarize and review	• Major steps in proced., rel. to principle, appropriate situations for application
Transfer knowledge	• To prob. solving, more complex proced's.
Remotivate and close	• Emphasize utility of proced. in terms of reliability and efficiency
Assessment	
Assess performance	• Identify situation to which procedure applies, correct order and completion of steps, recognition of correctly completed procedure
Feedback and remediation	• Identify common errors and misconceptions

Procedural rule learning: Gagné, 1985; Anderson, 1985; Teaching procedures: Gilbert, 1978, Landa, 1974; Marcone & Reigeluth, 1988; Schmidt & Gerlach, 1990; Wilson, 1985.

Strategy Elements for Problem-Solving Learning

Introduction	
Deploy attention Arouse interest and motivation	• Present a challenging and interesting problem that is represented in a novel manner.
Establish instructional purpose	• State class of problem that learners will learn to solve. • Delay statement in inquiry lesson.
Preview lesson	• Point out that problems will become increasingly complex throughout lesson.
Body	
Recall prior knowledge	• Explicitly review relevant prior knowledge: rules, declarative knowledge, or strategies. • Suggest ways that learners to reorganize knowledge in a more conducive form. • Attend to similarities and differences to other problem-solving learning.
Process information	• Encounter simplified, prototypical versions of problem first • Verbalize task requirements. • Provide model think-alouds. • Decompose problem into subgoals.
Focus attention	• Isolate critical attributes in given state and goal state.
Employ learning strategies	• Generate networks, analogies. • Monitor success of solutions. • Ask guiding questions and provide hints. • Represent problem in alternate forms. • Use print or other media as a form of external storage.
Practice	• Practice identifying and clarifying given and goal states. • Practice decomposing problem. • Practice evaluating adequacy of a provided solution. • Practice with well-defined problems first.
Evaluate feedback	• Model solution of process or provide models of solution. • Given hints or ask questions. • Provide information on efficiency as well as effectiveness of solution
Conclusion	
Summarize and review	• Restate criterial attributes of problem class. • Summarize effective strategies. • Suggest ways of organizing knowledge for storage and retrieval.
Transfer knowledge	• Find similar problems outside classroom. • Explicitly state when strategies may transfer to other problem types.
Remotivate and close	• Review the importance and breadth of what has been learned.
Assessment	
Assess performance	• Test ability to solve similar, but novel problems, both well-defined and poorly defined. • Test ability to isolate criterial attributes goal and given states. • Test ability to evaluate others' solutions. • Test ability to justify solutions.

Feedback and remediation	• Identify whether problems are in pattern recognition, decomposition, explaining solution, etc.

Domain-specific problem solving: Dunker, 1945; Gagné, 1980, 1985; Anderson, 1985; de Jong & Ferguson-Hessler, 1986, Alexander & Judy, 1988; Newell & Simon, 1972; Mental models: Johnson-Laird, 1983; Teaching of problem solving: Derry, Hawkes, & Tsai, 1987, Glaser, 1989; Mayer, 1985; Foshay, 1991

Strategy Elements for Cognitive Strategy Learning

Introduction	
Deploy attention Arouse interest and motivation Establish instructional purpose	• Experience task which requires the strategy • Discuss role of strategic thinking in learning
Preview lesson	• Demonstrate entire strategy model
Body	
Recall prior knowledge	• Recall previously learned strategies or tasks which seem similar
Process information	• Experience situations for which application of the strategy is appropriate and inappropriate • Model demo. strategy with think-aloud
Focus attention	• Critical attributes of tasks to which strategy is approp. • Cues that indicate successful application of strat.
Employ learning strategies	• Thinking aloud about cognition and monitoring effects of the strategy
Practice	• Identify contexts/tasks to which strategy is appropriate and explain why • Apply strategy to increasingly difficult tasks • Reciprocal practice
Evaluate feedback	• Peer evaluation • Group feedback - model appropriate application, examine artifacts of strategy use

Conclusion	
Summarize and review	• Summarize steps & review tasks to which strategy is appropriate
Transfer knowledge	• Move from detached to embedded with prompts, withdraw prompts • Compare strat. to others learned later
Remotivate and close	• Importance of effort coupled with strategy use
Assessment	
Assess performance	• Directly observe • Examine artifacts of strategy use

Feedback and remediation	• Was appropriate strategy selected? • Was strategy applied correctly? • Was success of strategy monitored and "fix up" strategies employed

Cognitive strategies: Derry & Murphy, 1986; Weinstein, 1982; Gagné & Driscoll, 1988; Davidson, 1988; Events for cognitive strategy instruction: Davidson & Smith, 1990; Deshler, Alley, Warner, & Schumaker, 1981; E. Gagné, 1985; Meichenbaum, 1977; Pressley, Snyder, & Gargilia-Bull, 1987; Weinstein, 1981

Strategy Elements for Attitude Learning

Introduction	
Deploy attention Arouse interest and motivation	• Engaging situation • Identification with characters or situation
Establish instructional purpose	• May be direct or indirect but to withhold for whole lesson is manipulative
Preview lesson	• May be indirect or withheld
Body	
Recall prior knowledge	• Present persuasion before expression of old attitude
Process information	• Persuasion, discussion, role-play, simulation
Focus attention	• Use of respected role model if persuasive tech. used --role model seen to receive valued reward
Employ learning strategies	• Use of acronyms, mnemonics, slogans for cognitive component as appropriate
Practice	• Practice cognitive, behavioral, & affective --know what to do, do it, know how it feels
Evaluate feedback	• Emphasize natural consequences • Include cognitive, behavioral, & affective aspects
Conclusion	
Summarize and review	• Clear restatement of desired behavior --purpose of instruction should be clear
Transfer knowledge	• Discuss applications, situations • Role play, simulations
Remotivate and close	• Realize how new learning can be used
Assessment	
Assess performance	• Ideal: behavior in actual free choice situation • Practical: role play or simulation of situations
Feedback and remediation	• Emphasize natural consequences • Include cognitive, behavioral, & affective aspects

Attitude learning: Martin & Briggs, 1986; Brandhorst, 1978; Zimbardo & Leippe, 1991; Attitude instruction: Fleming & Levie, 1978; Kiesler, Collins & Miller, 1969; Martin & Briggs, 1986.

Strategy Elements in Psychomotor Skill Learning

Introduction	
Deploy attention Arouse interest and motivation	• Focus on task • How new skill will help (may be implicit from preview or may need context of larger skill)
Establish instructional purpose	• What skill to be learned now should be clear
Preview lesson	• Overview what will be learned and how
Body	
Recall prior knowledge	• Point out the known skills that new skill uses
Process information	• Explanation then demonstration or • Explanation and demonstration together • Always organize by steps (subroutines) of the skill
Focus attention	• Learner activity during practice • Special attention for critical skills (dangerous, etc.)
Employ learning strategies	• Visualization of performance, mnemonics, analogies
Practice	• Distribution (whole/part) Scheduling (mass/spaced) • Sufficient for automaticity and desired skill level
Evaluate feedback	• External: suggestions, comments • Internal: proprioceptive, sensory
Conclusion	
Summarize and review	• Include re-cap of the steps in consolidating and clarifying fashion
Transfer knowledge	• Extended practice - maintenance of proficiency -- fundamental in many skills
Remotivate and close	• How apply in future; when use
Assessment	
Assess performance	• Observation of performance, performance rating
Feedback and remediation	• Learner needs clear idea of how well s/he can perform the skill and what to do next

Psychomotor learning: Fitts & Posner, 1967; Miller, Galanter, & Pribram, 1960; Oxendine, 1984, Robb, 1972; Singer, 1982; Instructional considerations: Practice: Harrison & Blakemore, 1989; Rothstein, Catelli, Dodds, & Manahan, 1981; Feedback: Ho & Shea, 1978; Magil, 1985; Newell, 1974; Rogers, 1974; Smoll, 1972

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